O I P E JC61
AUG 2 2 2005
PATENT & TRADEMARK OFFICE

Docket No.: 325772022400
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Kenichi SAWADA et al.

Application No.: 09/783,323

Confirmation No.: 3172

Filed: February 15, 2001

Art Unit: 2626

For: IMAGE FORMING APPARATUS HAVING A FUNCTION FOR CORRECTING COLOR DEVIATION AND THE LIKE

Examiner: Michael L. Burleson

SUBMISSION OF VERIFIED TRANSLATION OF FOREIGN PRIORITY DOCUMENT

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

This application claims priority under 35 USC 119 to Japanese patent application no. 2000-41936, filed February 18, 2000. Pursuant to 35 USC 119, a certified copy of said patent application was submitted on February 15, 2001, thereby perfecting the priority claim.

In support of the Applicants' claim for priority, filed herewith is a verified translation of the above-identified priority document.

It is respectfully requested that the receipt of the document attached hereto be acknowledged in this application.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing docket no. 325772022400.

Dated: August 22, 2005

Respectfully submitted,

By Deborah S. Gladstein

Deborah S. Gladstein
Registration No.: 43,636
MORRISON & FOERSTER LLP
1650 Tysons Blvd, Suite 300
McLean, Virginia 22102
703-760-7753

CERTIFICATION

I, Yasuo ITAYA, whose address is Tokushima Bldg., 7th Floor, 9-10, Minamisemba 3-chome, Chuo-ku, Osaka JAPAN, hereby certify that I am the translator of the attached document, namely Japanese Patent Application No. 2000-41936 filed on February 18, 2000, that I am familiar with both the Japanese language and the English language, and that the translation is a true and correct translation from the Japanese language to the English language to the best of my knowledge and belief.

This 12th day of August, 2005

Yasuo Itaya

Yasuo ITAYA

[Document Name] Application for patent

[Reference Number] TB12291

[Filing Date] February 18, 2000

[Addressee] To: Commissioner of the Patent Office

[International Patent Classification] G03G 15/01

[Inventor]

[Address] c/o Minolta Co., Ltd.
Osaka Kokusai Bldg. 3-13, 2-chome,
Azuchi-machi, Chuo-ku, Osaka

[Name] Kenichi SAWADA

[Inventor]

[Address] c/o Minolta Co., Ltd.
Osaka Kokusai Bldg. 3-13, 2-chome,
Azuchi-machi, Chuo-ku, Osaka

[Name] Junji NISHIGAKI

[Inventor]

[Address] c/o Minolta Co., Ltd.
Osaka Kokusai Bldg. 3-13, 2-chome,
Azuchi-machi, Chuo-ku, Osaka

[Name] Keisuke HASHIMOTO

[Inventor]

[Address] c/o Minolta Co., Ltd.
Osaka Kokusai Bldg. 3-13, 2-chome,
Azuchi-machi, Chuo-ku, Osaka

[Name] Kentaro KATORI

[Inventor]

[Address] c/o Minolta Co., Ltd.
Osaka Kokusai Bldg. 3-13, 2-chome,
Azuchi-machi, Chuo-ku, Osaka

[Name] Yoshihiko HIROTA

[Applicant]

[ID Number] 000006079

[Name] Minolta Co., Ltd.

[Representative] Yoshikatsu OTA

[Agent]

[ID Number] 100084375

[Patent Attorney]

[Name] Yasuo ITAYA

[Indication of charge]

[Prepayment Account Number] 009531

[Amount of Payment] 21,000 yen

[List of attached documents]

[Document Name] Specification, 1 copy

[Document Name] Drawings, 1 copy

[Document Name] Abstract, 1 copy

[Necessity of Proof] Necessary

[Document name] Specification

[Title of The Invention] IMAGE FORMING APPARATUS

[Claims]

1. An image forming apparatus which forms an image by exposing an image carrier by emitting light of light emitting elements based on image data, comprising:

an input device for inputting distortion data of the exposure unit; and,

a controller which controls an exposure position of an image by the exposure unit, based on the distortion data input by the input device.

2. An image forming apparatus having a solid-scanning type exposure unit for exposing an image carrier by emitting light of light emitting elements based on image data, and forms an image by converting a latent image exposed by the exposure unit and formed on the image carrier into a visible image and transferring the visible image onto a transfer body, comprising:

an input device for inputting distortion data of the exposure unit;

a resist pattern forming device which forms predetermined resist patterns on the transfer body;

at least two optical sensors which read out the resist patterns formed by the resist pattern forming device;

a correction data processor which obtains a relative deviation amount in main and sub scanning directions of the exposure unit based on a read-out result of the resist patterns by the optical sensors, and forms skew correction data based on the relative deviation amount; and,

a controller which controls an exposure position of an image by the exposure unit based on the skew correction data formed by the correction data processor and the distortion data input by the input device.

[Detailed description of the invention]

[0001]

[Field of the invention]

This invention relates to an image forming apparatus that forms images using an exposure unit for exposing an image carrier based on image data.

[0002]

[Background art]

Conventionally, in an image forming apparatus such as a digital copier, a printer, a facsimile apparatus, there has been known a solid-scanning head (hereinafter referred to as LED head) such as an LED array as an exposure

device (exposure unit) for exposing an image to a photoconductor. Compared with an optical-scanning device such as a laser (hereinafter referred to as LD head), the LED head is superior in properties of a smaller number of moving parts, a high degree of reliability, and a construction that can be miniaturized and save space. The LED head is driven based on image data generated from document information that is read out by an image reader in the image forming apparatus, or image data that is transmitted from outside of the apparatus, thereby emitting light, exposing the photoconductor, and forming an electrostatic latent image. The electrostatic latent image is developed for forming an image on a sheet.

[0003]

This kind of the image forming apparatus is desired to reproduce images without color deviation in color images forming operations. Especially, in a tandem system that has a plurality of image forming units for each of colors images and multi-transfers images formed by each of units onto single transfer body, it is necessary to detect an error between image forming positions of each of units, and to correct the image data. For this purpose, a resist mark or pattern predetermined for each of units is formed on the transfer body, and optically read out by a detector, thereby adjusting the positions.

[0004]

Here, referring to FIG. 13, a method for detecting color deviation in an image forming apparatus using a conventional LD head is explained. The apparatus is equipped with optical sensors S1, S2 and S3 that are located in front, middle and back sides of a transfer belt V in a main-scanning direction (LD scanning direction) in a downstream side from an image forming unit, the resist determining patterns are formed on the transfer belt V in a sub-scanning direction, and the resist determining patterns are determined by each of the sensors. Each of patterns of black (K), cyan (C), magenta (M) and yellow (Y), consisting of horizontal lines and oblique lines, is formed at a predetermined interval. Then, the pattern images are read out for calculating deviation amounts of the cyan, magenta and yellow image patterns to the reference K image pattern. Based on the detected value, the deviation amounts of C, M and Y to the reference color K is corrected by approximating to a secondary curve. The correcting method is carried out by storing correcting coefficient data on a memory, and executing drawing timing control in response to the data. A curve shown in FIG. 13 indicates curvature (bow) occurring in the image.

[0005]

It should be noted that, as shown in FIG. 14, elements of the color deviation include deviation in the main-scanning direction, in sub-scanning direction, in angles (skew), in scanning lines (bow), and scaling ratio in the main-scanning direction.

[0006]

The above method for correcting the color deviation by the conventional three-sensor structure has problems such as (1) the cost increases, (2) the processing system is complicated, (3) approximative errors occur, and (4) if the method is applied to the image forming apparatus using the LED head, linear distortion of the LED exposure unit itself cannot be detected. Further, in the image forming apparatus using the LED head (exposure unit), since bow distortion and deviation in main scaling ratio due to characteristics of optical systems do not occur, only deviation in the main/sub-scanning directions, and skew are required to be corrected. Therefore, correction of color deviation can be conducted by a two-sensor structure, that is low cost.

[0007]

[Problems to be solved by the invention]

However, the LED exposure unit has a problem that the linear distortion of the exposure unit itself may be caused by distortion (during manufacturing) in linear property of LED arrays, or distortion during assembly of the exposure unit of the LED arrays. This distortion cannot be detected by sensors. Besides, the linear distortion of the exposure unit itself may have a curvature profile of the high order, which cannot be handled even by a three-sensor structure.

[0008]

This invention is made to solve the above-mentioned problems. The object of the present invention is to provide an image forming apparatus which can correct linear distortion of an exposure unit itself with ease when a solid-scanning type exposure unit such as an LED head is used, and can correct the distortion and the skew at the same time with a simple and inexpensive structure, thereby realizes reproduction of images without color deviation.

[0009]

[Means for solving the problems and Effect of the invention]

In order to achieve the above-mentioned objects, according to one aspect of the present invention, an image forming apparatus which forms an image by exposing an image carrier by emitting light of light emitting elements based on image data, comprising: an exposure unit which exposes

an image carrier by emitting light of light emitting elements based on image data; an input device for inputting distortion data of the exposure unit; and a controller which controls an exposure position of an image by the exposure unit, based on the input distortion data.

[0010]

In the present invention, a preliminarily obtained linear distortion data of an exposure unit can be input with a panel, etc. which constitute an input device, and an exposure position of an image is corrected and controlled by a controller based on the distortion data. This enables a correction of an image deviation caused by a linear distortion of a solid-scanning type exposure unit itself, which can not be detected by sensors. The distortion data can be input on a pixel basis, a predetermined pixel basis, or with a representative point, and may be stored in a memory. Furthermore, when the data is input with a representative point, the data is constitute of a main scanning address and a distortion amount, and based on the data, approximative data of high order data may be calculating as an amount of correcting distortion.

[0011]

Further, according to the present invention, an image forming unit having a solid-scanning type exposure unit for exposing an image carrier by emitting light of light emitting elements based on image data, and forms an image by converting a latent image exposed by the exposure unit and formed on the image carrier into a visible image and transferring the visible image onto a transfer body, comprising: an input device for inputting distortion data of the exposure unit; a resist pattern forming device which forms predetermined resist patterns on the transfer body; at least two optical sensors which read out the resist patterns formed by the resist pattern forming device; a correction data processor which obtains a relative deviation amount in main and sub scanning directions of the exposure unit based on a read-out result of the resist patterns by the optical sensors, and forms skew correction data based on the relative deviation amount; and a controller which controls an exposure position of an image by the exposure unit based on the skew correction data formed by the correction data processor and the distortion data input by the input device.

[0012]

According to the present invention, the optical sensor device may be two-sensor structure that is low cost. And an exposure (drawing) position of an image by an exposure unit can be adjusted based on added data which is obtained by adding (making a composition of) skew correction data

formed by read-out of resist patterns by optical sensors, and distortion data input by a input device. Therefore, using the skew correction data formed on the base of read-out of resist patterns by sensors, a correction of position deviation in a main/sub scanning direction, which occurs during assembly of a solid-scanning type exposure unit, and of skew can be conducted. And concurrently, using distortion data input by a input device, a correction of distortion of an exposure unit itself which can not be detected by sensors can be conducted.

[0013]

Also, an amount of color deviation to a reference color can be calculating by forming patterns of plural colors as resist patterns at predetermined timing in which a reference color is included, and by reading out the patterns with sensors. Accordingly, a color deviation correction is conducted, which realizes reproduction of an image without color deviation. Besides, adding process of the skew correction data and the distortion data input may be performed by storing the skew correction data and the distortion data in a memory, and reading out the data from a memory according to a main scanning address.

[0014]

[Detailed description of the preferred embodiment of the present invention]

Now, an image forming apparatus according to one embodiment of the present invention will be explained with reference to the FIG. 1. As shown in FIG. 1, the image forming apparatus is a tandem type digital full-color copier (hereinafter simply referred to as copier), having photoconductor drums 1Y, 1M 1C and 1K for respectively forming images of yellow (Y), magenta (M), cyan (C) and black (K). The copier comprises an image reader 2 for reading out image data of a document, and a printer 3 for printing images on a sheet. The image reader 2 is provided with a scanner having a full-color CCD sensor 4 for converting light reflected from the document into electrical signals (analog signals) of red (R), green (G) and blue (B), and outputting the signals into an image signal processor 5 that is provided in the printer 3.

[0015]

The image signal processor 5 generates digital image signals which have been converted the image signals into colors of cyan (C), magenta (M), yellow (Y) and black (K), and drives print heads for each of colors through a driver 6 based on the signals. The print head comprises LED arrays 7Y, 7M, 7C, and 7K (solid-scanning type exposure unit) constituted of many optical chips arranged in a main scanning direction. The LED arrays are

contained in a process cartridge having photoconductor drums 1Y, 1M, 1C, 1K for forming respective color images.

[0016]

Light from the LED arrays 7Y, 7M, 7C and 7K of the print heads exposes the photoconductor drums 1Y, 1M, 1C and 1K, and forms an electrostatic latent images of each of colors Y, M, C and K. The electrostatic latent images of each of colors are developed by developing devices 8Y, 8M, 8C and 8K for each of colors, that are respectively provided in process cartridges for each of colors. Toner images of each of colors on the photoconductor drums 1Y, 1M, 1C and 1K are sequentially intermediate-transferred to a transfer belt 9 for forming a superposed image of each of colors. The superposed image is sent to a transfer position to a sheet by a movement of the transfer belt 9. The sheet contained in paper-feeding cassettes 11 and 12 is transmitted to the transferring position in synchronization with the image on the transfer belt 9, and the image on the transfer belt 9 is re-transferred by a secondary transfer roller 14. The toner image on the sheet is fixed by a fixing roller 15, then the sheet is discharged into a tray 16.

[0017]

The above copier includes two optical sensors (S1 and S2 in later-described FIG. 9) that are arranged in a line in a scanning direction of the LED arrays in a downstream side from each of the process cartridges on the transfer belt 9, and forms predetermined resist pattern images of plural colors on the transfer belt 9 as necessary to read out the resist patterns with the optical sensors. Based on the read-out result and separate input data, the image signal processor 5 creates a correction data of the image data, and carries out correcting process for the image data to be transmitted to the LED arrays.

[0018]

FIG. 2 shows an example of an image data correcting process circuit of the image signal processor 5. In the figure, the correcting processor circuit comprises a CPU 21 which directs the correcting process, a data input device 22 (corresponding to an input panel shown in FIG. 8) which inputs predetermined linear distortion data of the exposure unit and bow distortion data, a skew correction memory 23 which stores skew correction data created based on the input data and a determined read-out result of the resist patterns by the sensors , an address arithmetic computer 24 which calculates a corrected exposure (drawing) position of pixels, and an image data memory 25. Besides, the correcting process circuit is provided with a

main-scanning address generator 26 and a sub-scanning address generator 27 for address arithmetic. "DOTCLK" means a dot-clock signal, "_HWE" a write-enable signal, "_HSYNC" a horizontal synchronous signal, and "_VIAIN" a vertical synchronous signal. As to image data, each of C, M, Y and K data is input. In this circuit constitution, the CPU 21 (correction data generator, exposure position controller) performs arithmetic computation to determine a relative amount of deviation about the main and sub scanning directions of the exposure unit, and updates skew correction data stored in the skew correction memory 23.

[0019]

FIG. 3 shows a modified example of the image data correcting process circuit of the image signal processor 5. In the figure, it is to be noted that the same components as those of the above-described are denoted by the same reference numerals. As shown in this feature, in the circuit, the CPU 21 which is connected with a bow-correction control parameter input device 28, and a distortion data storage memory 29 which stores distortion data of a pixel basis obtained by arithmetic computations based on the input from the bow-correction control parameter input device 28, and a skew correction memory 30 which stores skew correction data of a pixel basis obtained by arithmetic computations based on the determining result of the resist patterns are provided. Besides, this correction process circuit comprises a data composition unit 31 instead of the address arithmetic computer 24, thereby adds each of data stored in the distortion data storage memory 29 and skew correction memory 30 in order to calculate the corrected exposure (drawing) position of the pixels.

[0020]

Here, the bow distortion and correction data thereof are shown in FIG. 4, and a method of correcting process for occurrence of the skew and bow is shown in FIG. 5. As to the bow correction data, an amount of correction (D1, D2, D3 ... D7680) for every address of each of pixels in the LED arrays is input in a temporal memory in the CPU 21 in response to a condition of the bow (in FIG. 2), or held in the distortion data storage memory 29 (FIG. 3). As to the correction of the image data, the image without distortion is formed by adding the memorized bow correction data and the created skew correction data to the image data.

[0021]

FIG. 6 is a flowchart showing a process procedure of the CPU 21 illustrated in above FIG. 2. The skew correction amount by determining the reference resist pattern is calculated (#1), the skew correction amount

is written into the memory 23 (#2), and the linear-distortion data of the exposure unit is input (#3). Then, according to the address in the main-scanning direction output from the main-scanning address generator 26 (#4), the above two kinds of data are added (#5), and the skew correction data is updated (#6). After that, the skew correction data to which the distortion data is added is read out (#7), and control of the image data position (control of sub-scanning address of the image data memory) based on the result of the adding operation is conducted (#8).

[0022]

FIG. 7 is a flowchart showing a process procedure of the CPU 21 illustrated in the above FIG. 3. It is to be noted that the same or similar processes as those of the above are denoted by the same step numbers. The skew correction amount by determining the reference resist pattern is calculated (#1), the skew correction amount is written into the memory 30 (#2), and the distortion data of the exposure unit is input (#3). Then, the distortion data is written into the memory (#14), and, according to the address in the main scanning direction output from the main-scanning address generator 26 (#15), the distortion data and the skew correction data are read out (#16). After that, these data is added in the data composition unit 31 (#17) to proceed #8.

[0023]

FIG. 8 shows construction of a distortion data input panel composing the above input devices 22 and 28, and shows its operation procedure. In the figure, panel screens are illustrated in time sequence, in which [A] is a distortion data input screen, [B] a input method selecting screen, [C] a distortion data input interval screen, [D] a distortion data input screen, [E] a specified position input screen, and [F] a input error example screen. The panel transits to the proper screen in response to the input method selected by a user.

[0024]

The above distortion data of the exposure unit (LED array) to be input is preliminarily obtained by an arbitrary method. As the concrete arbitrary method, there are several methods such as a method of obtaining a in-focus profile by a measuring device of a separate camera, etc. with illuminating all of the elements on one line of LED arrays, and a method of judging the amount of the distortion based on the printed result obtained by forming an image (printing) by exposing one line, or there is a case that the distortion data is found by the data of the device. Besides, the process of detecting the amount of the correction, writing into the memory, inputting data and

the like can be executed at proper timing such as a timing of turning on the power or an initial adjustment at a shipment of the apparatus.

[0025]

FIGS. 9 – 11 show a structure for detecting an amount of color deviation in the main and sub scanning directions (hereinafter, referred to as main deviation and sub deviation, which correspond to skew correction amount) by a determination of the read-out of resist patterns using two sensors, and show a detecting method. A sensor 1 (S1) and a sensor 2 (S2) are arranged in positions that keep a certain distance from each other in the main scanning direction to a center of the LED array 7Y (7M, 7C and 7K). Each of the resist patterns for detecting main deviation and for detecting sub deviation is printed on a transfer belt almost corresponding to each of sensors in which reference color K and other three colors Y, M and C are sequentially printed keeping a predetermined distance in a pattern-moving direction (an example is illustrated only about the reference color in FIG 9). The pattern for detecting the main deviation is composed of horizontal lines and oblique lines, whereas the pattern for detecting the sub deviation is composed of horizontal lines. The sensors detect an amount of relative color deviation of patterns of each of colors to the reference color pattern (It is to be noted that the pattern deviation to the center positions of the sensors is compensated by below-explained detection of a deviation amount).

[0026]

As shown in FIG. 10, the amount of the main scanning color deviation corresponds to difference between a time interval (or distance) of reading out the horizontal line and oblique line of the reference color, and a time interval (or distance) of reading out the horizontal line and oblique line of the other colors. Besides, as shown in FIG. 11, the amount of the sub scanning color deviation corresponds to difference between a determined distance (or time) of the horizontal line of the reference color and the horizontal line of the other colors in the sub scanning direction, and a distance (or time) between the reference lines. In both of the above cases, the amount of the color deviation is detected on a pixel basis. Further, when each of the colors is deviated with respect to the reference color in the minus direction of the main scanning and sub scanning, the amount of the color deviation is decided to be minus value.

[0027]

Based on the two points of the main-scanning addresses obtained by the determination using the above two sensors, and the amount of sub-scanning color deviation in these addresses, a relational expression

(the primary line approximation of the amount of correcting sub-scanning skew) of the main-scanning dot address and the amount of sub-scanning color deviation in whole one line can be calculated. The outline of it is shown in FIG. 12. In the figure, a horizontal line Xd indicates main scanning dot address (dot), a vertical line g (Xd) amount of sub-scanning color deviation (dot), M1 and M2 main-scanning dot addresses corresponding to sensor positions, and Y1 and Y2 the amount of sub-scanning color deviation in the addresses (a relational expression is given for each of colors with respect to a reference color). The expression of a primary line connecting these two points is represented as follows. The relational expressions for Y, M, and C is determined, and are stored in the memory (memory 23 in FIG. 2, and memory 30 in FIG. 3).

$g(Xd) = a*Xd + Y0$

in this expression, inclination: $a = (Y1 - Y2)/(M1 - M2)$

intercept: $Y0 = -a*M1 + Y1$

[0028]

The image forming apparatus of the present embodiment adjusts the exposure positions by adding the skew correction data created by the sensor detection of the resist patterns, and the distortion data input from the input device, which makes it possible to correct the deviation of the positions in the main and sub scanning directions occurred during assembly of the LED exposure unit, and the skew by means of the sensor detection, and at the time, to correct the distortion of the exposure unit itself that cannot be detected by the sensors with the input data, thereby the reproduction of the image without color deviation is realized.

[0029]

It is to be understood that the present invention is not limited to the structures of the above embodiments, and various changes and modifications are possible. For example, although the above embodiment shows that the exposure position is adjusted by adding the skew correction data created based on read-out of the resist patterns by the sensors, and the distortion data of the exposure unit input from the input device, the present invention is also capable of coping with the distortion that cannot be detected by the sensors even in the case of adjusting the exposure position based on the distortion data of the exposure unit input from the input device. Besides, the above embodiment shows that the sensors read out the resist patterns formed on the transfer belt, but it is also possible to print the resist patterns on a sheet by the printer 3 of FIG. 1, and to read out the resist patterns by a scanner using the full-color CCD sensor 4 of the image reader 2.

[Brief description of the drawings]

FIG. 1 is a view showing a configuration of an image forming apparatus according to one embodiment of the present invention;

FIG. 2 is a block diagram showing an example of an image data correcting process circuit of the above image forming apparatus.

FIG. 3 is a block diagram showing other example of an image data correction processing circuit;

FIG. 4 shows bow distortion and correction data thereof;

FIG. 5 shows a method of correcting process in the case of occurrence of skew and bow;

FIG. 6 is a flowchart showing a process procedure of the circuit shown in FIG. 2;

FIG. 7 is a flowchart showing a process procedure of the circuit shown in FIG. 3;

FIG. 8 is a view showing a structure of a distortion data input panel and its operation procedure;

FIG. 9 is a view showing a structure for detecting an amount of color deviation in main/sub scanning;

FIG. 10 explains a method of detecting an amount of color deviation in main scanning;

FIG. 11 explains a method of detecting an amount of color deviation in sub scanning;

FIG. 12 is a graphic showing a relational expression of main-scanning dot addresses and an amount of color deviation in sub scanning;

FIG. 13 is a view explaining a method of detecting color deviation in a conventional image forming apparatus; and,

FIG. 14 explains elements of color deviation.

[Explanation of reference]

5 image signal processor

7Y, 7M, 7C,and 7K LED array (solid-scanning type exposure unit)

9 transfer belt (transfer body)

21 CPU (correction data processor, exposure position controller)

22 bow correction data input device (input device)

23 skew correction memory

28 bow-correction control parameter input device (input device)

29 distortion data storage memory

30 skew correction memory

S1 and S2 optical sensor

[Document name] Abstract

[Problem to be solved] To correct linear distortion of the exposure unit itself with ease, and also to correct concurrently the distortion and the skew with simple structure and at low cost by an image forming apparatus using a solid-scanning type exposure unit such as LED head.

[Solution] A skew correction amount is detected by read-out of resist patterns by optical sensors (#1), distortion data of an exposure unit is input by input device (#3), these data are added (#5), skew correction data is updated (#6). Based on the skew correction data, an exposure position of an image by the exposure unit is adjusted (#8). This constitution allows correction of positional deviation in main/sub scanning direction occurred during assembly of the solid-scanning type exposure unit, and of the skew. And concurrently the distortion of the exposure unit itself which can not be detected by sensors is conducted.

[Selected drawing] FIG.6

FIG. 1

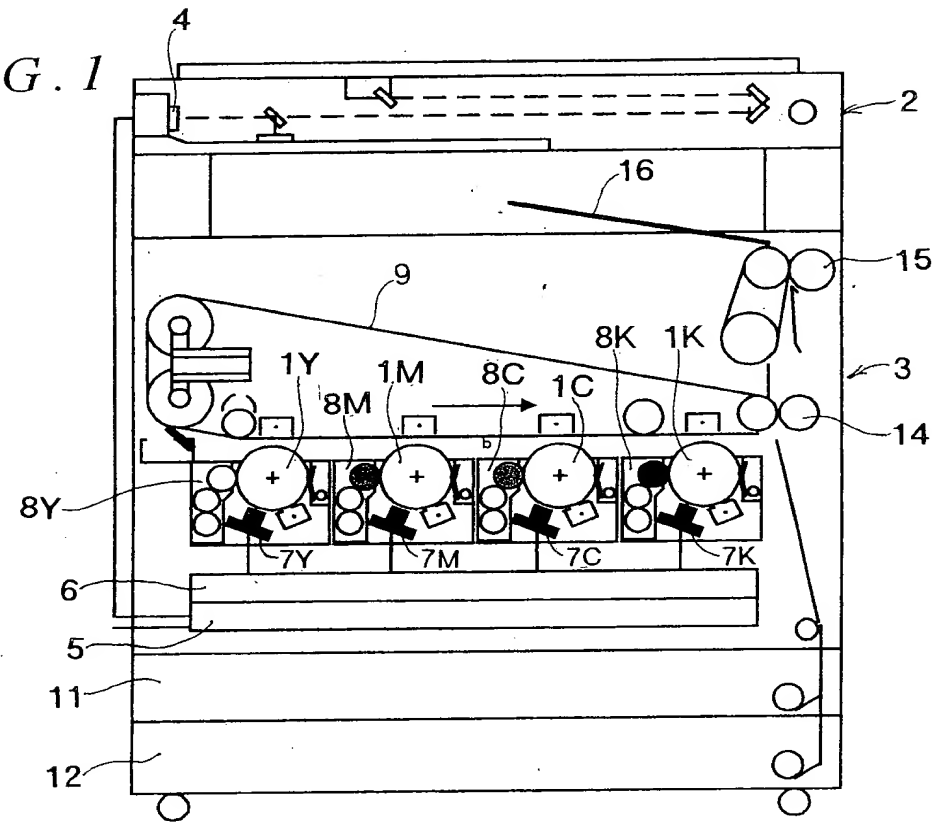


FIG. 2

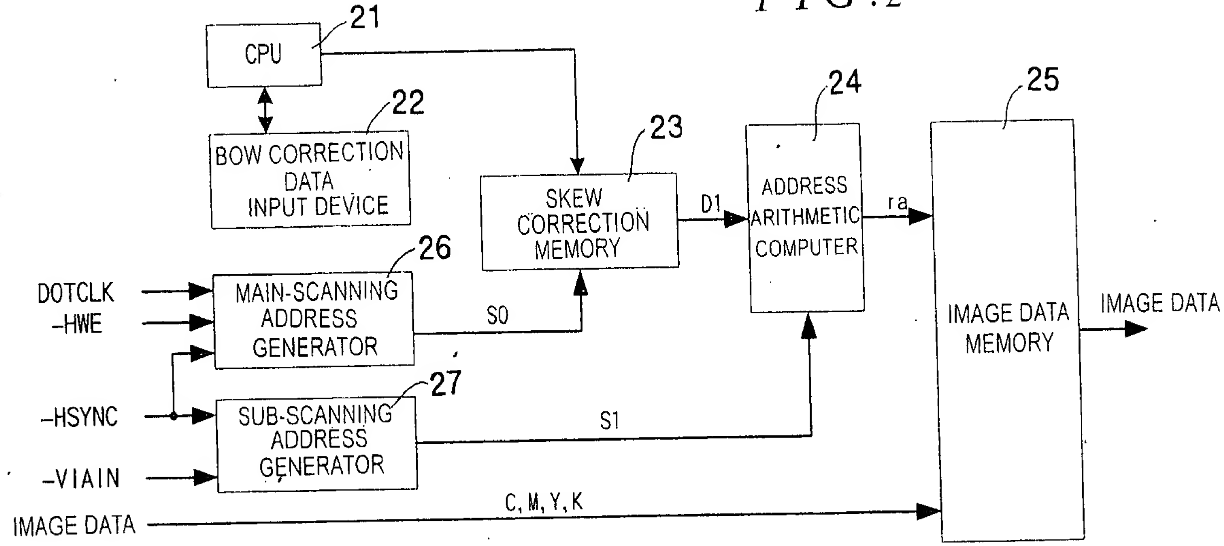

CPU
21
BOW CORRECTION DATA INPUT DEVICE
22
SKEW CORRECTION MEMORY
23
ADDRESS ARITHMETIC COMPUTER
24
IMAGE DATA MEMORY
25
MAIN-SCANNING ADDRESS GENERATOR
26
SUB-SCANNING ADDRESS GENERATOR
27
DOTCLK
-HWE
-HSYNC
-VIAIN
IMAGE DATA
S0
S1
D1
ra
C, M, Y, K
IMAGE DATA

FIG. 3

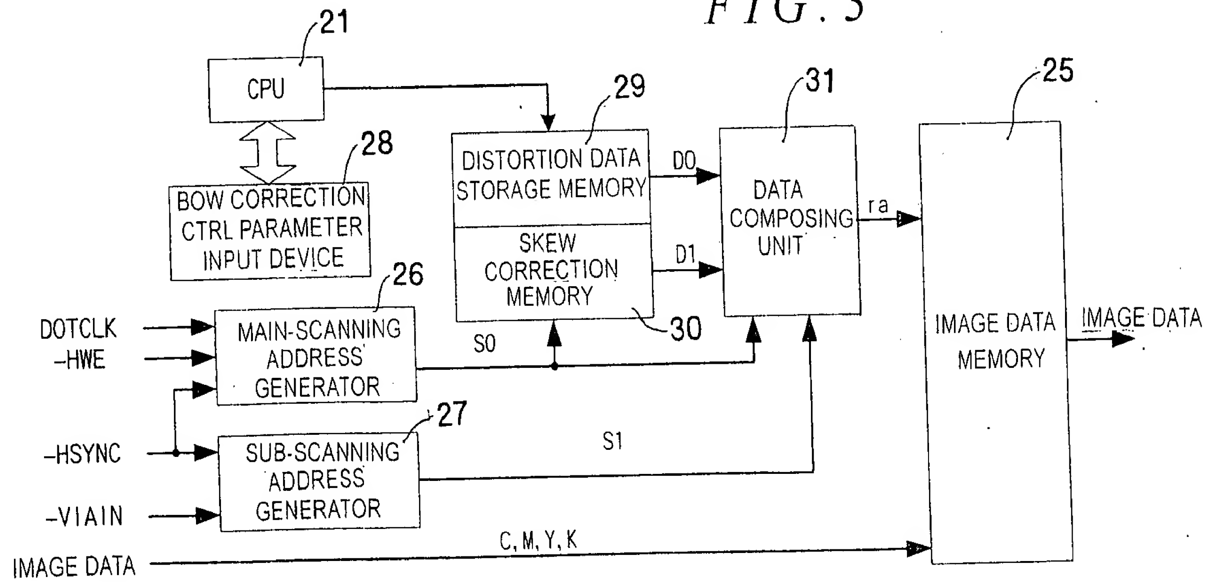

CPU
21
BOW CORRECTION CTRL PARAMETER INPUT DEVICE
28
DISTORTION DATA STORAGE MEMORY
29
SKEW CORRECTION MEMORY
30
DATA COMPOSING UNIT
31
IMAGE DATA MEMORY
25
MAIN-SCANNING ADDRESS GENERATOR
26
SUB-SCANNING ADDRESS GENERATOR
27
DOTCLK
-HWE
-HSYNC
-VIAIN
IMAGE DATA
S0
S1
D0
D1
ra
C, M, Y, K
IMAGE DATA

FIG. 4

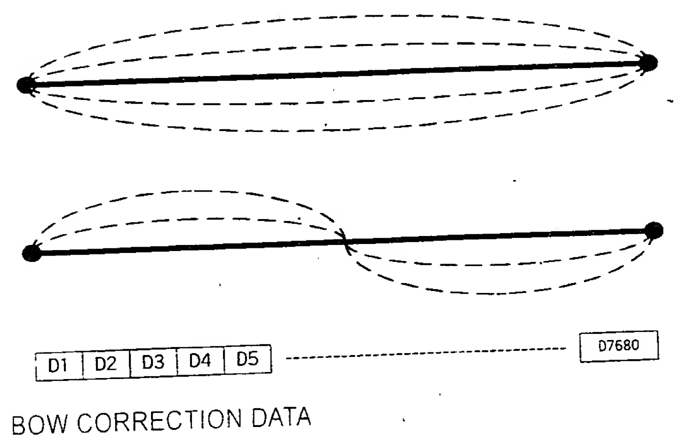

D1
D2
D3
D4
D5
D7680
BOW CORRECTION DATA

FIG. 5

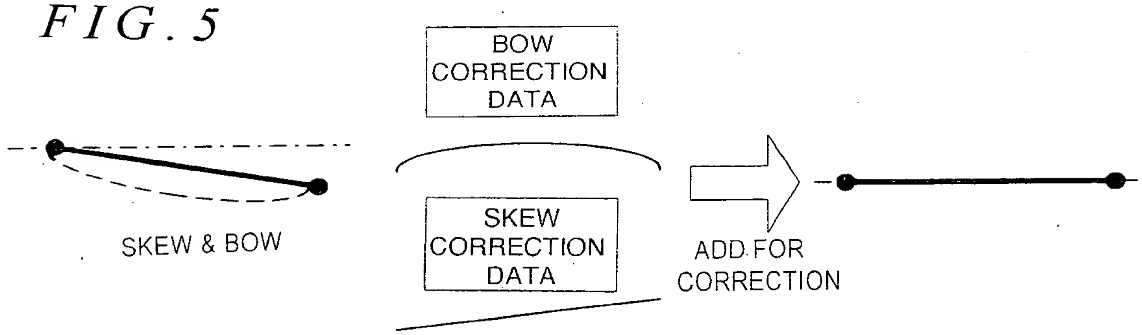

SKEW & BOW
BOW CORRECTION DATA
SKEW CORRECTION DATA
ADD FOR CORRECTION

FIG. 6

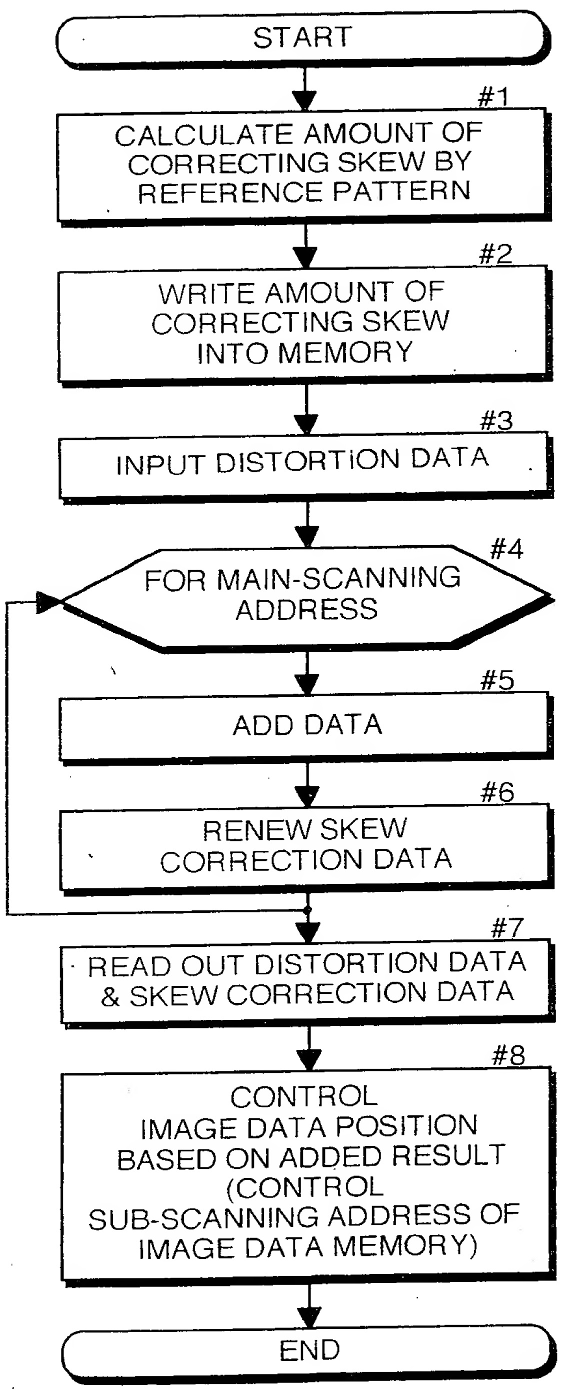

START
#1
CALCULATE AMOUNT OF CORRECTING SKEW BY REFERENCE PATTERN
#2
WRITE AMOUNT OF CORRECTING SKEW INTO MEMORY
#3
INPUT DISTORTION DATA
#4
FOR MAIN-SCANNING ADDRESS
#5
ADD DATA
#6
RENEW SKEW CORRECTION DATA
#7
READ OUT DISTORTION DATA & SKEW CORRECTION DATA
#8
CONTROL IMAGE DATA POSITION BASED ON ADDED RESULT (CONTROL SUB-SCANNING ADDRESS OF IMAGE DATA MEMORY)
END

FIG.7

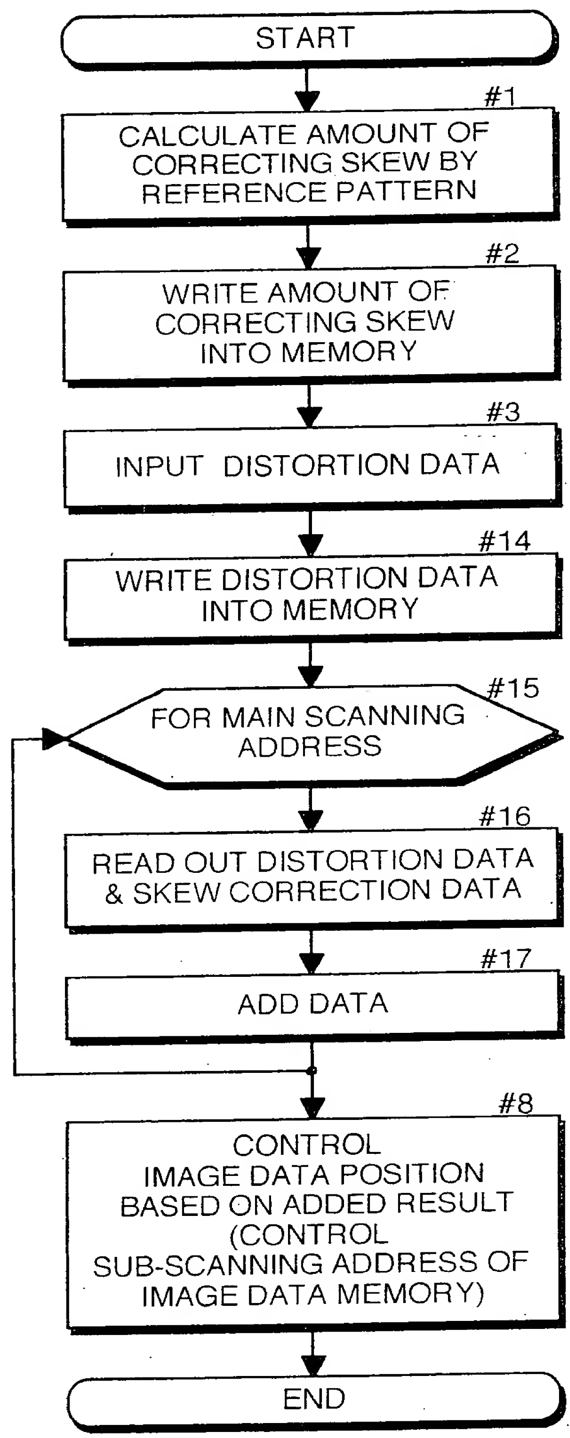
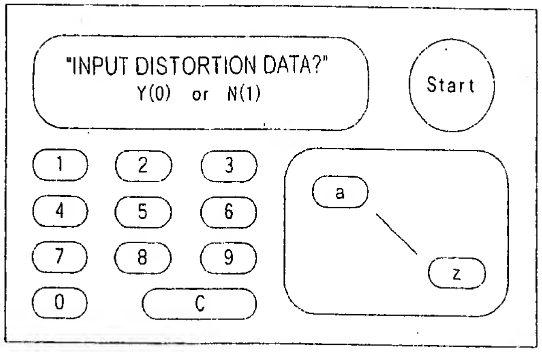
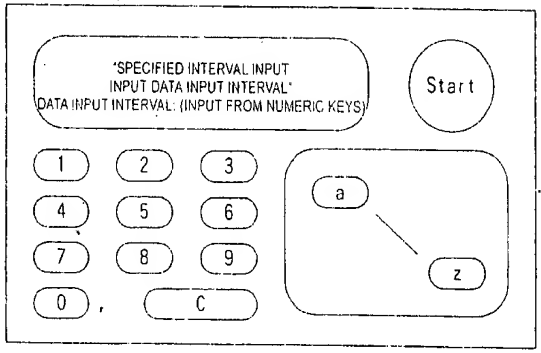

START
#1
CALCULATE AMOUNT OF CORRECTING SKEW BY REFERENCE PATTERN
#2
WRITE AMOUNT OF CORRECTING SKEW INTO MEMORY
#3
INPUT DISTORTION DATA
#14
WRITE DISTORTION DATA INTO MEMORY
#15
FOR MAIN SCANNING ADDRESS
#16
READ OUT DISTORTION DATA & SKEW CORRECTION DATA
#17
ADD DATA
#8
CONTROL IMAGE DATA POSITION BASED ON ADDED RESULT (CONTROL SUB-SCANNING ADDRESS OF IMAGE DATA MEMORY)
END

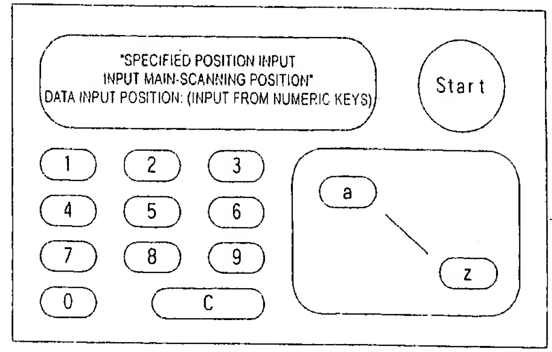
FIG.8 DISTORTION DATA INPUT PANEL



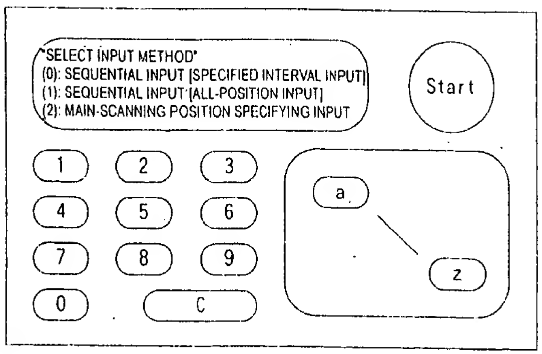
[A: DISTORTION DATA INPUT SCREEN]



[C: DISTORTION DATA INPUT INTERVAL SCREEN]
HEREAFTER, GO TO D

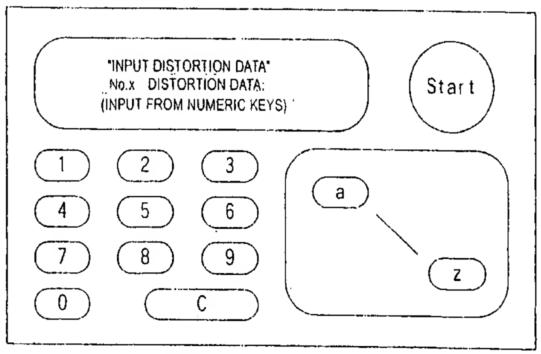


[E: SPECIFIED POSITION INPUT SCREEN]
HEREAFTER, GO TO D

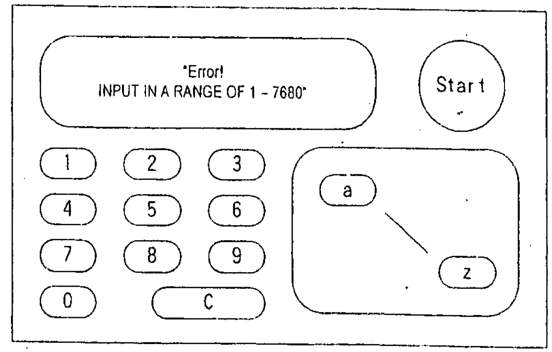


[B: INPUT METHOD SELECTING SCREEN]

(0) → TO C
(1) → TO D
(2) → TO E

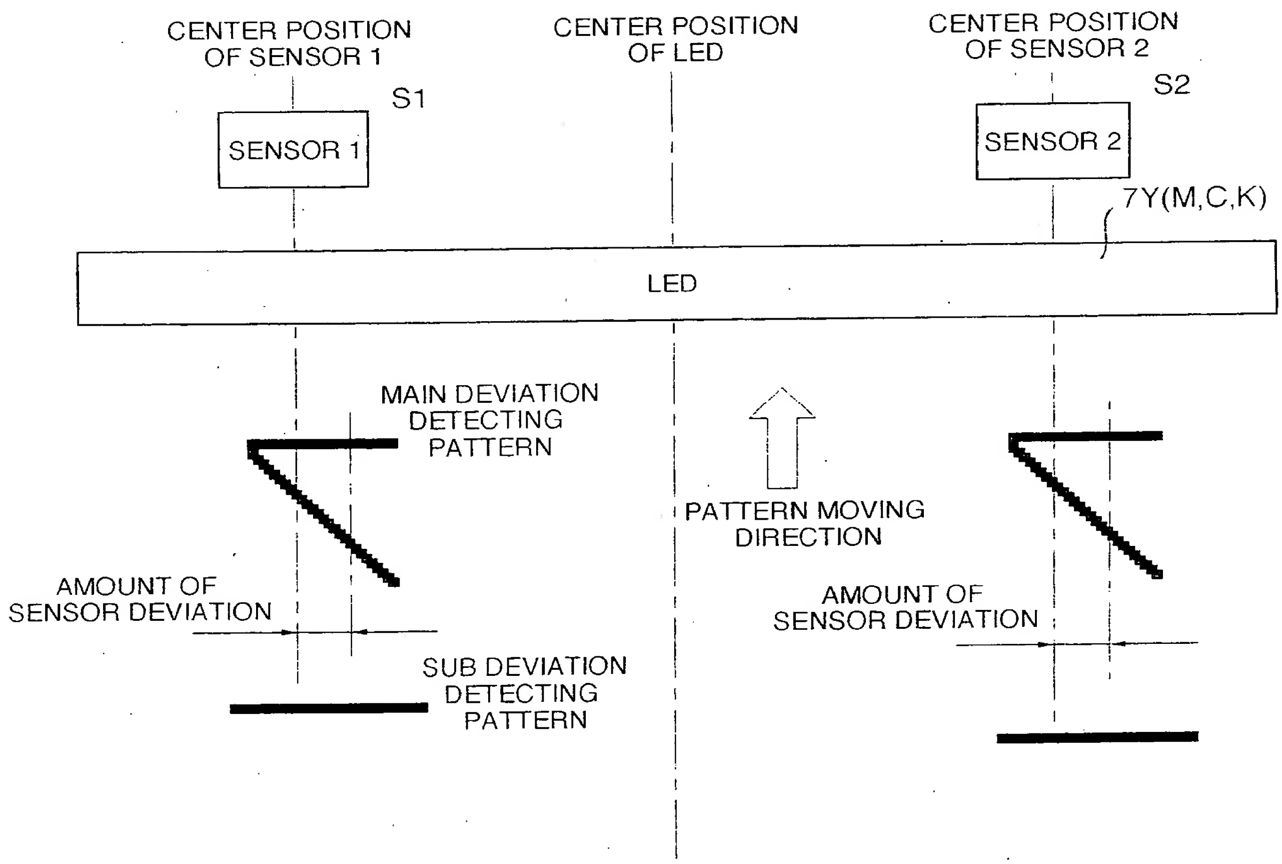


[D: DISTORTION DATA INPUT SCREEN]



[F: EXAMPLE OF INPUT ERROR]

FIG. 9



CENTER POSITION OF SENSOR 1
CENTER POSITION OF LED
CENTER POSITION OF SENSOR 2
S1
SENSOR 1
S2
SENSOR 2
7Y(M,C,K)
LED
MAIN DEVIATION DETECTING PATTERN
PATTERN MOVING DIRECTION
AMOUNT OF SENSOR DEVIATION
AMOUNT OF SENSOR DEVIATION
SUB DEVIATION DETECTING PATTERN

FIG.10

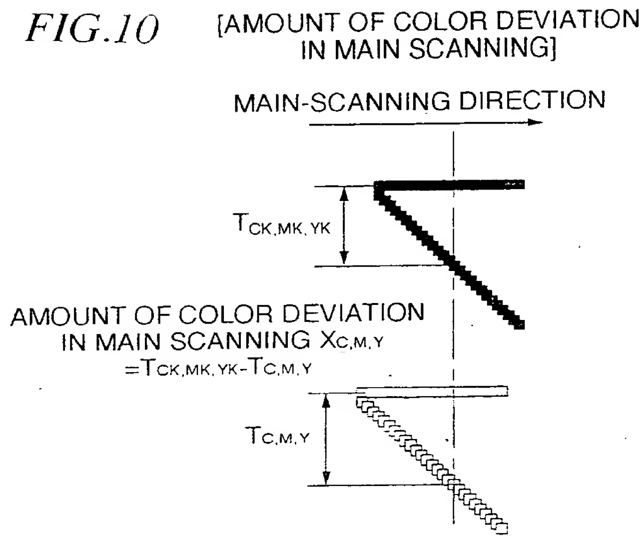


FIG.11

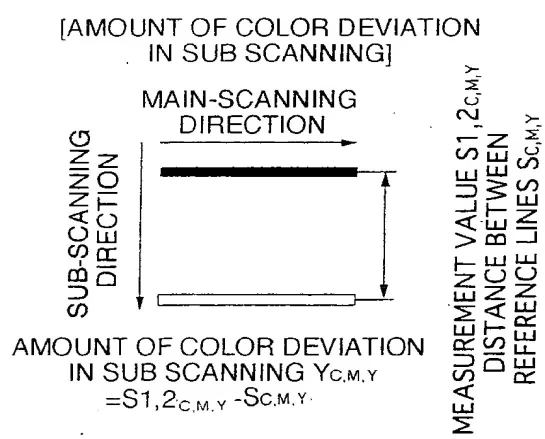


FIG.12

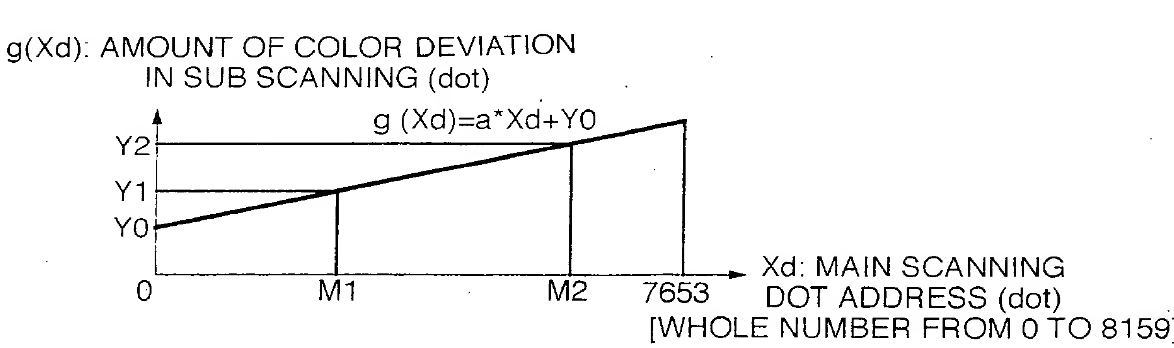


FIG.13

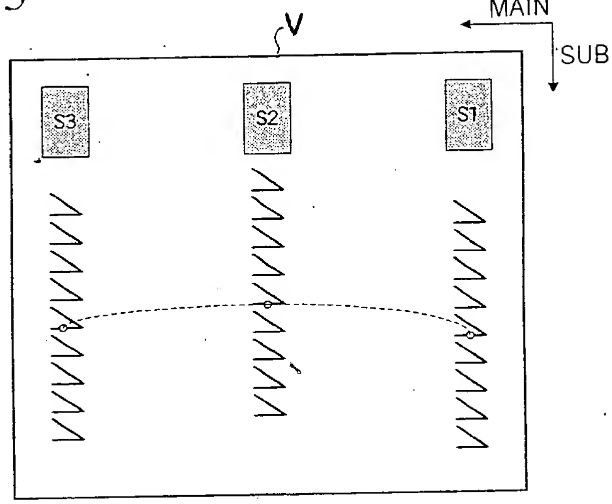


FIG.14

ELEMENTS OF COLOR DEVIATION
-DEVIATION IN MAIN-SCANNING DIRECTION
-DEVIATION IN SUB-SCANNING DIRECTION
-ANGLE DEVIATION (SKEW)
-DEVIATION IN SCANNING LINE (BOW)
-SCALING RATIO IN MAIN-SCANNING DIRECTION